

APPENDIX E

MONITORING PLANS

STANDARDS, METHODS, AND INTENSITY BY MANAGEMENT ZONE

AND ALTERNATIVE

MONITORING AND ADAPTIVE MANAGEMENT

Introduction

General resource inventory (and monitoring) and adaptive management are two approaches to assure the implementation and success of management actions. General resource inventory and monitoring in accordance with the National Park Service (NPS) 77 Resource Management Guidelines (NPS 1991) is a necessary part of the decision that proceeds from the Winter Use Final SEIS.

The two approaches are distinguished by the degree of uncertainty regarding the impacts to park values. Adaptive management is an appropriate approach when important information pertaining to natural resource and visitor use management is lacking, and there is a need to take immediate management action rather than to wait for additional information to be collected. It is a process of implementing management decisions as scientifically driven experiments that test predictions and assumptions in management plans, and using the resulting information to improve the plans. General resource monitoring is appropriate where standards exist either in laws, regulations or general management plans. Techniques must be available to measure conditions for effective comparison with the standard.

Additionally, the National Parks Omnibus Act of 1998 requires a program of inventory and monitoring of National Park System resources to establish baseline information and to provide information on long-term trends of the condition of national park system resources (16 U.S.C. 5934). The service also must use the results of scientific research, including monitoring and inventory, in making decisions about the management of parks (16 U.S.C. 5936).

The Winter Use SEIS identifies information needs related to winter use as it may impact critical park values: air quality, natural quiet, wildlife, aquatic resources, and visitor experience. Both adaptive management and monitoring require standards, or thresholds, to establish baselines upon which to assess degradation to monitored park values. The initial identification of indicators, standards, methods and management responses that relate to critical values is located in SEIS appendix X. This is the basis for developing monitoring plans.

Coordination and Responsibility Requirements

Monitoring programs will be coordinated between Yellowstone and Grand Teton National Parks. The programs will function and be coordinated through the planning staffs of both parks. The development of annual plans and reports will be coordinated through the planning

units, and the planning units will be responsible for delivering those products to management. Other park divisions will coordinate with planning, and provide resources for performing monitoring tasks.

Adaptive Management Program

The essential first step when formulating an adaptive management strategy for the affected environment is to articulate the critical uncertainties, particularly where some information is known about a specific resource but conclusive evidence is currently unavailable. Based on current knowledge, a management scenario is then designed to test specific hypotheses relating to the critical uncertainties. Monitoring and evaluation strategies are then employed to evaluate outcomes relative to acceptable thresholds, and assist in the development of management alternatives. Monitoring within the framework of adaptive management is critical because of the uncertainty of predictions based on limited information. It provides systematic feedback for management, and allows adjustment of activities to mitigate unplanned or undesirable outcomes.

A critical step in adaptive management involves the National Environmental Policy Act (NEPA). Each time a new management proposal is evaluated the analysis must be documented by performing the appropriate level of NEPA compliance. Some actions, such as permanent road closures to protect wildlife or the construction of new facilities may require an additional site-specific NEPA analysis, which includes public scoping. Some actions might be administrative in nature, or be implementable through application of a NEPA categorical exclusion (Ref: NPS 12).

The adaptive management process is shown schematically in Appendix E. The tables that follow that prescribe monitoring standards, methods and proposed management actions for critical resources in each winter management zone under each of the three alternatives. These are tables 1 through 36.

Monitoring Program

General resource monitoring applies when adequate information exists to make informed management decisions. It is the process of collecting information to evaluate if the objectives of a management plan are being realized. General monitoring techniques (as opposed to monitoring conducted within the adaptive management framework) will be employed to assess impacts to public health and safety; geothermal features; water quality; threatened and endangered species; trumpeter swans and some aspects of visitor experience, including access and circulation. NPS-77, Natural Resources Management Guideline, will be used initially as a

guide to monitoring specific resource areas. As new techniques are developed, or as commonly accepted procedures become available, monitoring protocols will change.

Tables follow that prescribe monitoring standards, methods and possible management actions for critical resources in each winter management zone. These are tables 1 through 9 for alternatives 1,2 and 4 and 18 through 27 for alternative 3.

Annual Monitoring and Adaptive Management Plans

The overall objective for monitoring and adaptive management is to assess the long-term effects of management actions on park resources and values. Specific objectives accrue to each winter management zone (SEIS Table xx and Figures xx and xx). With reference to the following tables, for each management zone and for each resource of concern, monitoring indicators are presented. For each indicator, a standard either exists or is hypothesized (for adaptive management). Also, for each indicator a monitoring method and intensity is prescribed. Finally, management actions are indicated if the standards should be exceeded.

Monitoring and adaptive management plans will be developed annually during work planning and budget processes for the coming year. Plans will be developed through the planning staffs of both park units. Monitoring will be conducted on a sampling basis for the purpose of effective use of funds and personnel. The guiding principle for monitoring is to collect purposeful data – even if the amount is limited – rather than collecting a great deal of data that cannot be used statistically to arrive at valid conclusions. Therefore, monitoring plans will be brief and will cover the following items:

- The zones to be sampled, along with the indicators, standards, and methods to be used.
- Specific locations for monitoring, and the planned intensity – frequency of monitoring.
- A schedule (times) for data collection and submittal.
- The division or individual that is responsible for monitoring and reporting.

It is expected that initial monitoring will be intensive, both in geographic and temporal extent, so that correlations can be made and results can be extrapolated. It is also expected that monitoring over time will become less intensive and arrive at a low intensity, maintenance level. Sampling schedules can vary from year to year, focusing on different areas within the park units. Monitoring plans will continue to be coordinated between Yellowstone and Grand Teton so that common methods are used, efficiency is achieved, and results are comparable.

Annual monitoring reports will be written and publicized through the planning units of the two parks.

Annual Monitoring and Adaptive Management Reports

Feedback for management is implicit in monitoring and adaptive management programs. In order for feedback to occur, data must be collected effectively in accordance with a plan. Data must be captured in an accessible information system, capable of evaluation and statistical manipulation. Then, evaluations must be put in meaningful terms for management. The requirement of a formal report is essential to meet this need. The report should be published to a standard that is appropriate for public consumption.

Annual monitoring reports will be brief, and will meet the following requirements:

- Sum up the information collected during the year.
- Express conclusions relating to each management zone and indicator that was monitored.
- Extrapolate the conclusions to other areas, when possible and appropriate.
- State the need for applying management actions based on monitoring.
- Make recommendations for changes in monitoring locations, protocols, techniques or thresholds that should be considered in the monitoring plan for the following year.

APPENDIX E

ALTERNATIVES 1a, 1b, 3

Table 1. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	1 Destination or Support Area				
RESOURCE VALUE	Indicator	PRELIMINARY STANDARD	Method	Monitoring Intensity*	Management Actions
Air Quality and Public Health	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Establish vehicle carrying capacity Adjust vehicle numbers Review annually
	Park workers and visitors exposure to CO, particulate matter, aldehydes,	State and federal ambient air quality standards	Fixed site sampling of PM and carbon monoxide, and VOCs Reference method fixed site sampling of PM and carbon monoxide	High	Establish vehicle carrying capacity Adjust vehicle numbers Review annually
		State and federal personal exposure air quality standards	Personal samples for exposure to aldehydes carbon monoxide, and particulate matter	High	Reduce exposure to emissions Reduce emissions Review annually
Wildlife	Bird and mammal habituation re.effectiveness of garbage facilities	Garbage unavailable to wildlife	Photo surveys, and observation	High	Increase or improve garbage security Increase garbage storage Review annually
Water/Snowpack	Water quality: pH, hydrogen, ammonium, calcium, sulfate, nitrate, and VOCs	State and federal water quality standards	Surface water sampling Snowpack sampling	Moderate	Determination and application of best management practices Reduce emissions and vehicle numbers Review annually
Safety	Vehicle accidents and incidents	Continual improvement three-year sliding average	Incident descriptions and GIS mapping	High	Sign and reduce speed limits in areas of recurring incidents Increase law enforcement and information programs in areas of concern Review monthly
Geothermal Features	Human-caused damage to geothermal areas	No degradation of geothermal resources	Remote sensing and visual observation	High	Increase enforcement and monitoring Implement additional information programs Restrict travel Review monthly
Visitor Experience	Waiting lines	Visitors wait no more than 5 minutes to access restrooms and park information	Observation	Moderate	Increase facilities where possible Increase information programs Review annually

Management Zone →	1 Destination or Support Area				
RESOURCE VALUE	Indicator	PRELIMINARY STANDARD	Method	Monitoring Intensity*	Management Actions
	Perceptions of crowding at attraction sites	Visitors are able to see, smell, and hear the natural environment at popular attraction sites such as Old Faithful or Jackson lake	Visitor survey	High	Establish carrying capacities Review every other year
	Visitor satisfaction with opportunities to experience park values (wildlife viewing, scenery, and clean air), affordable services, and access to information	Visitors are highly satisfied with their park experience	Visitor survey	High	Establish carrying capacities Review every other year

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the season.

ALTERNATIVES 1a, 1b, 3

Table 2. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	2 Plowed Road				
Resource Value	Indicator	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Establish vehicle carrying capacity Review annually
	Park workers and visitors exposure to CO, particulate matter, aldehydes,	State and federal ambient air quality standards	Fixed site sampling of PM and carbon monoxide, and VOCs Reference method fixed site sampling of PM and carbon monoxide	High	Establish vehicle carrying capacity Review annually
		State and federal personal exposure air quality standards	Personal samples for exposure to aldehydes, VOCs, and particulate matter		
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	High	Increase enforcement Review annually
Water/ Snowpack	Water quality: pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate and VOCs	State and Federal water quality standards	surface water sampling Snowpack sampling	Moderate	Establish vehicle carrying capacity Determination and application of best management practices Review annually

Management Zone →	2 Plowed Road				
Resource Value	Indicator	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Safety	Motor vehicle accidents Motorized vs. nonmotorized visitor conflict	Continuous improvement three-year sliding average	Incident reports and GIS	High	Sign and reduce speed limits in areas of recurring incidents Increase law enforcement in areas of concern Review monthly
Visitor Experience	Encounter rates	Visitors are able to see, smell, and hear the natural environment at roadside pullouts and interpretive trails	Visitor survey	High	Establish vehicle carrying capacity Adjust vehicle numbers Review annually
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude	Visitors are highly satisfied (+90%) with their park experience	Visitor survey	High	Establish vehicle carrying capacity Adjust vehicle numbers Review annually

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the season.

ALTERNATIVES 1a, 1b, 3

Table 3. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	3 Groomed Motorized Route				
Resource Value	Indicator	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Establish vehicle carrying capacity Adjust vehicle numbers Review annually
	Park workers and visitors exposure to CO, particulate matter, aldehydes,	State and federal ambient air quality standards	Fixed site sampling of PM and carbon monoxide, and VOCs Reference method fixed site sampling of PM and carbon monoxide	High	Establish vehicle carrying capacity Adjust vehicle numbers Review annually
		State and federal personal exposure air quality standards	Personal samples for exposure to aldehydes, VOCs, and particulate matter		
			Establish exposure measurements for snowcoaches		

Management Zone →	3 Groomed Motorized Route				
Resource Value	Indicator	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	Moderate	Increase enforcement Review annually
Water/ Snowpack	Water quality: pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards Snowpack sampling	Spring runoff surface water sampling Snowpack sampling	High	Establish vehicle carrying capacity Determination and application of best management practices Review annually
Safety	Oversnow vehicle accidents	Continuous improvement three-year sliding average	Incident reports and GIS	High	Sign and reduce speed limits in areas of recurring incidents. Increase law enforcement in areas of concern Review monthly
Visitor Experience	Encounter rates	Not to exceed 250 vehicles per hour for more than 1 hour per day. Visitors are able to see, smell, and hear the natural environment at roadside pullouts and interpretive trails	Visitor survey	High	Establish carrying capacities Adjust visitor numbers Review every other year
	Smoothness of groomed surface	No worse than fair 20% of a 24-hour period	Visual observation/visitor survey		
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude.	Visitors are highly satisfied (+ 90%) with their park experience.	Visitor survey	High	Establish carrying capacities Adjust visitor numbers Review every other year

ALTERNATIVES 1a, 1b, 3

Table 4. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	4 Groomed Motorized Trail				
	Resource Value	Indicator	Preliminary Standard	Method	Monitoring Intensity* Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Establish vehicle carrying capacity/adjust vehicle numbers Review annually
	Park workers and visitors exposure to CO, particulate matter, aldehydes,	State and federal ambient air quality standards	Fixed site sampling of PM and carbon monoxide, and VOCs Reference method fixed site sampling of PM and carbon monoxide	High	Establish vehicle carrying capacity/adjust vehicle numbers Review annually
		State and federal personal exposure air quality standards	Personal samples for exposure to aldehydes, VOCs, and particulate matter		
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	High	Increase law enforcement Review annually
Water/ Snowpack	Surface water sampling of pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards	Spring runoff surface water sampling	High	Determination and application of best management practices Adjust vehicle numbers Implement or require new technologies Review annually
Safety	Oversnow vehicle accidents	Continuous improvement three-year sliding scale	Incident reports and GIS	High	Sign and reduce speed limits in areas of recurring incidents. Increase law enforcement in areas of concern. Review monthly
	Conflicts between motorized and nonmotorized use				
Visitor Experience	Encounter rates	Not to exceed 16 to 20 parties per day 80% of the time. Visitors are able to see, smell, and hear the natural environment at roadside pullouts and interpretive trails	Visitor survey	High	Establish carrying capacity/Adjust visitor numbers Review every other year
	Smoothness of groomed surface	No worse than fair 30% of the winter season	Visual observation	Low	Improve or increase grooming Adjust vehicle numbers Review annually
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude.	Visitors are highly satisfied (+ 90%) with their park experience.	Visitor survey	High	Establish carrying capacities Adjust visitor numbers Review every other year

ALTERNATIVES 1a, 1b, 3
Table 5 Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks
and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	5 Ungroomed Motorized Trail				
Resource Value	INDICATOR	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Establish vehicle carrying capacity /adjust vehicle numbers Review annually
	Park workers and visitors exposure to CO, particulate matter, aldehydes,	State and federal ambient air quality standards	Fixed site sampling of PM and carbon monoxide, and VOCs Reference method fixed site sampling of PM and carbon monoxide	High	Establish vehicle carrying capacity /adjust vehicle numbers Review annually
		State and federal personal exposure air quality standards	Personal samples for exposure to aldehydes, VOCs, and particulate matter		
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	High	Increase law enforcement Review annually
Water/Snowpack	Surface water sampling of pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards	Spring runoff surface water sampling	Low	Determination and application of best management practices Adjust vehicle numbers Implement or require new technologies Review annually
Safety	Oversnow vehicle accidents	Continuous improvement three-year sliding scale	Incident reports and GIS	Low	Sign and reduce speed limits in areas of recurring incidents. Increase law enforcement in areas of concern Review monthly
	Conflicts between motorized and nonmotorized use				
Visitor Experience	Encounter rates	Not to exceed 16 to 20 parties per day 80% of the time. Visitors are able to see, smell, and hear the natural environment at roadside pullouts and interpretive trails	Visitor survey	Low	Establish carrying capacity/adjust visitor numbers Review every other year
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude	Visitors are highly satisfied (+90%) with their park experience	Visitor survey	Low	Establish carrying capacities/ Adjust visitor numbers Review every other year

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the season.

ALTERNATIVES 1a, 1b, 3

Table 6. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	6 Groomed Nonmotorized Trail				
	Indicator	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Establish vehicle carrying capacity/ Adjust vehicle numbers Review annually
	Park workers and visitors exposure to CO, particulate matter, aldehydes,	State and federal ambient air quality standards	Fixed site sampling of PM and carbon monoxide, and VOCs Reference method fixed site sampling of PM and carbon monoxide	High	Establish vehicle carrying capacity/ Adjust vehicle numbers Review annually
		State and federal personal exposure air quality standards	Personal samples for exposure to aldehydes, VOCs, and particulate matter		
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	High	Increase law enforcement Review annually
Water/Snowpack	Surface water sampling of pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards	Spring runoff surface water sampling	Low	Determination and application of best management practices. Adjust vehicle numbers. Implement or require new technologies. Review annually
Safety	Conflicts between motorized and nonmotorized use Search and rescue Human and wildlife conflicts	Continuous improvement three-year sliding scale	Incident reports and GIS	Low	Increase law enforcement and information programs in areas of concern Review monthly
Visitor Experience	Encounter rates	Not to exceed 10 to 15 parties per day over 70% of the use season. Visitors are able to see, smell, and hear the natural environment at roadside pullouts and interpretive trails	Visitor survey	Low	Establish carrying capacity/ Adjust visitor numbers Review every other year
	Smoothness of groomed surface	No worse than fair 30% of the winter season	Visual observation	Low	Improve or increase grooming Adjust vehicle numbers Review annually
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude.	Visitors are highly satisfied (+90%) with their park experience	Visitor survey	Low	Establish carrying capacities/ Adjust visitor numbers Review every other year

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the season.

ALTERNATIVES 1a, 1b, 3

Table 7. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	7 Ungroomed Nonmotorized Trail or Area				
	Resource Value	Indicator	Preliminary Standard	Method	Monitoring Intensity* Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Establish vehicle carrying capacity/ Adjust vehicle numbers Review annually
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	High	Increase law enforcement Review annually
Water/ Snowpack	Surface water sampling of pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards	Spring runoff surface water sampling	Low	Determination and application of best management practices Review annually
Safety	Conflicts between motorized and nonmotorized use SEARCH AND RESCUE Human and wildlife conflicts	Continuous improvement three-year sliding scale	Incident reports and GIS	High	Increase law enforcement and information programs in areas of concern Review monthly
Visitor Experience	Encounter rates	Not to exceed 10 to 15 parties per day over 70% of the use season. Visitors are able to see, smell, and hear the natural environment at roadside pullouts and interpretive trails	Visitor survey	Low	Establish carrying capacity/ Adjust visitor numbers Review every other year
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude	Visitors are highly satisfied (+90%) with their park experience	Visitor survey	Low	Establish carrying capacities/ Adjust visitor numbers Review every other year

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the season.

ALTERNATIVES 1a, 1b, 3

Table 8. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	8 Backcountry Nonmotorized Trail or Area				
Resource Value	Indicator	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Establish vehicle carrying capacity/ Adjust vehicle numbers Review annually
	Human and grizzly bear conflicts during pre- or post denning period	No incidents	Mapping of denning areas and visitor use patterns and trends Incident reports	High	Increase law enforcement and information programs Close denning areas to human use in fall and spring Review annually
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	High	Increase law enforcement Review annually
Water/ Snowpack	Surface water sampling of pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards	Spring runoff surface water sampling Snowpack sampling	Moderate	Determination and application of best management practices Implement or require new technologies Review annually
Safety	Search and rescue Human and wildlife conflicts	Continuous improvement three-year sliding scale	Incident reports and GIS	High	Increase law enforcement and information programs in areas of concern Review monthly
Visitor Experience	Encounter rates	Not to exceed 5 to 10 parties per day over 80% of the use season. Visitors are able to see, smell, and hear the natural environment and experience quiet and solitude	Visitor survey	Low	Establish carrying capacity/adjust visitor numbers Review every other year
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude	Visitors are highly satisfied (+90%) with their park experience	Visitor survey	Low	Establish carrying capacities/adjust visitor numbers Review every other year

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the season.

ALTERNATIVES 1a, 1b, 3

Table 9. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	9 Sensitive Resource Area				
	Indicator	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Air Quality (Public Health)	Visibility/Success of closure	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Evaluate success of closure Review annually
Wildlife	Human and grizzly bear conflicts during pre- or post denning period/closure	No incidents	Mapping of denning areas Incident reports	High	Evaluate success of closure Review annually
Water/Snowpack	Surface water sampling of pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards	Spring runoff surface water sampling Snowpack sampling	Moderate	Evaluate success of closure Review annually
Safety	Search and rescue Human and wildlife conflicts	No incidents	Incident reports and GIS	High	Evaluate success of closure Review annually

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the season.

ALTERNATIVE 2

Table 10. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Zone →	1 Destination or Support Area				
RESOURCE VALUE	Indicator	PRELIMINARY STANDARD	Method	Monitoring Intensity*	Management Actions
Air Quality and Public Health	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Establish vehicle carrying capacity adjust vehicle numbers Review annually
	Park workers and visitors exposure to CO, particulate matter, aldehydes,	State and federal ambient air quality standards	Fixed site sampling of PM and carbon monoxide, and VOCs. Reference method fixed site sampling of PM and carbon monoxide	High	Establish vehicle carrying capacity adjust vehicle numbers Review annually
		State and federal personal exposure air quality standards	Personal samples for exposure to aldehydes, VOCs, and particulate matter	High	Adjust exposure to emissions/Adjust emissions. Review annually
Wildlife	Bird and mammal habituation re; effectiveness of garbage facilities	Garbage unavailable to wildlife	Photo surveys, and observation	High	Increase or improve garbage security Increase garbage storage Review annually
Water/ Snowpack	Water quality: pH, hydrogen, ammonium, calcium, sulfate, nitrate, and VOCs	State and federal water quality standards	Surface water sampling Snowpack sampling	Moderate	Determination and application of best management practices. Reduce emissions and vehicle numbers. Review annually
Safety	Vehicle accidents and incidents	Continual improvement three-year sliding average	Incident descriptions and GIS mapping	High	Sign and reduce speed limits in areas of recurring incidents. Increase law enforcement and information programs in areas of concern. Review monthly
Geothermal Features	Human-caused damage to geothermal areas	No degradation of geothermal resources	Remote sensing and visual observation	High	Increase enforcement and monitoring Implement additional information programs Restrict travel. Review monthly
Visitor Experience	Waiting lines	Visitors wait no more than 5 minutes to access restrooms and park information	Observation	Moderate	Increase facilities where possible. Increase information programs. Review annually
	Perceptions of crowding at attraction sites	Visitors are able to see, smell, and hear the natural environment at popular attraction sites such as Old Faithful or Jackson lake not less than 90% of each 24-hour period	Visitor survey	High	Establish carrying capacities Review every other year
	Visitor satisfaction with opportunities to experience park values (wildlife viewing, scenery, and clean air), affordable services, and access to information	Visitors are highly satisfied (90%+) with their park experience	Visitor survey	High	Establish carrying capacities Review every other year

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the season.

ALTERNATIVE 2

Table 11. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	2 Plowed Road				
Resource Value	Indicator	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Establish vehicle carrying capacity Review annually
	Park workers and visitors exposure to CO, particulate matter, aldehydes,	State and federal ambient air quality standards	Fixed site sampling of PM and carbon monoxide, and VOCs Reference method fixed site sampling of PM and carbon monoxide	High	Establish vehicle carrying capacity Review annually
		State and federal personal exposure air quality standards	Personal samples for exposure to aldehydes, VOCs, and particulate matter		
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	High	Increase enforcement Review annually
Water/Snowpack	Water quality: pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate and VOCs	State and Federal water quality standards	surface water sampling Snowpack sampling	Moderate	Establish vehicle carrying capacity Determination and application of best management practices Review annually
Safety	Motor vehicle accidents Motorized vs. nonmotorized visitor conflict	Continuous improvement three-year sliding average	Incident reports and GIS	High	Sign and reduce speed limits in areas of recurring incidents Increase law enforcement in areas of concern Review monthly
Visitor Experience	Encounter rates	Not to exceed 250 vehicles per hour for more than 1 hour per day.	Visitor survey	High	Establish carrying capacities/adjust visitor numbers Review every other year
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude	Visitors are highly satisfied (90%+) with their park experience	Visitor survey	High	Establish carrying capacities/ adjust visitor numbers Review every other year

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the season.

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Table 12. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	3 Groomed Motorized Route				
	Indicator	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Establish vehicle carrying capacity/ adjust vehicle numbers Implement/require new technologies Review annually
	Park workers and visitors exposure to CO, particulate matter, aldehydes,	State and federal ambient air quality standards	Fixed site sampling of PM and carbon monoxide, and VOCs Reference method fixed site sampling of PM and carbon monoxide	High	Establish vehicle carrying capacities adjust vehicle numbers Implement/require new technologies Review annually
		State and federal personal exposure air quality standards	Personal samples for exposure to aldehydes, VOCs, and particulate matter		
			Establish exposure measurements for snowcoaches		
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	Moderate	Increase enforcement Review annually
Water/Snowpack	Water quality: pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards Snowpack sampling	Spring runoff surface water sampling Snowpack sampling	High	Establish vehicle carrying capacity Determination and application of best management practices Review annually
Safety	Oversnow vehicle accidents	Continuous improvement three-year sliding average	Incident reports and GIS	High	Sign and reduce speed limits in areas of recurring incidents. Increase law enforcement in areas of concern Review monthly
Visitor Experience	Encounter rates	Not to exceed 250 vehicles per hour for more than 1 hour per day.	Visitor survey	High	Establish carrying capacities adjust visitor numbers Improve or increase grooming Review every other year
	Smoothness of groomed surface	No worse than fair 35% of the winter season	Visual observation/visitor survey		
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude.	Visitors are highly satisfied (90%+) with their park experience	Visitor survey	High	Establish carrying capacities/adjust visitor numbers Review every other year

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the season.

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Table 13. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	4 Groomed Motorized Trail				
Resource Value	Indicator	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Establish vehicle carrying capacity/adjust vehicle numbers Implement/require new technologies Review annually
	Park workers and visitors exposure to CO, particulate matter, aldehydes,	State and federal ambient air quality standards	Fixed site sampling of PM and carbon monoxide, and VOCs Reference method fixed site sampling of PM and carbon monoxide	High	Establish vehicle carrying capacity/adjust vehicle numbers Implement/require new technologies Review annually
		State and federal personal exposure air quality standards	Personal samples for exposure to aldehydes, VOCs, and particulate matter		
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	High	Increase law enforcement Review annually
Water/Snowpack	Surface water sampling of pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards	Spring runoff surface water sampling	High	Determination and application of best management practices Adjust vehicle numbers Implement/require new technologies Review annually
Safety	Oversnow vehicle accidents	Continuous improvement three-year sliding scale	Incident reports and GIS	High	Sign and reduce speed limits in areas of recurring incidents. Increase law enforcement in areas of concern. Review monthly
	Conflicts between motorized and nonmotorized use				
Visitor Experience	Encounter rates	Not to exceed 16 to 20 parties per day 80% of the time.	Visitor survey	High	Establish carrying capacity/adjust visitor numbers Review every other year
	Smoothness of groomed surface	No worse than fair 35% of the winter season	Visual observation	Low	Improve or increase grooming Adjust vehicle numbers Review annually
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude.	Visitors are highly satisfied (90%+) with their park experience	Visitor survey	High	Adjust visitor numbers Review every other year

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the

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Table 14. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	5 Ungroomed Motorized Trail				
Resource Value	INDICATOR	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Establish vehicle carrying capacity /adjust vehicle numbers Implement/require new technologies Review annually
	Park workers and visitors exposure to CO, particulate matter, aldehydes,	State and federal ambient air quality standards	Fixed site sampling of PM and carbon monoxide, and VOCs Reference method fixed site sampling of PM and carbon monoxide	High	Establish vehicle carrying capacity /adjust vehicle numbers Implement/require new technologies Review annually
		State and federal personal exposure air quality standards	Personal samples for exposure to aldehydes, VOCs, and particulate matter		
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	High	Increase law enforcement Review annually
Water/Snowpack	Surface water sampling of pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards	Spring runoff surface water sampling	Low	Determination and application of best management practices Adjust vehicle numbers Implement/require new technologies Review annually
Safety	Oversnow vehicle accidents	Continuous improvement three-year sliding scale	Incident reports and GIS	Low	Sign and reduce speed limits in areas of recurring incidents. Increase law enforcement in areas of concern Review monthly
	Conflicts between motorized and nonmotorized use				
Visitor Experience	Encounter rates	Not to exceed 16 to 20 parties per day 80% of the time.	Visitor survey	Low	Establish carrying capacity/adjust visitor numbers Review every other year
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude	Visitors are highly satisfied (90%+) with their park experience	Visitor survey	Low	Establish carrying capacities/adjust visitor numbers Review every other year

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the season.

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Table 15. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	6 Groomed Nonmotorized Trail				
	Indicator	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Implement/require new technologies for grooming equipment. Adjust vehicle numbers on adjacent motorized routes or trails. Review annually
	Park workers and visitors exposure to CO, particulate matter, aldehydes,	State and federal ambient air quality standards	Fixed site sampling of PM and carbon monoxide, and VOCs. Reference method fixed site sampling of PM and carbon monoxide	High	Implement/require new technologies for grooming equipment Adjust vehicle numbers on adjacent motorized routes or trails Review annually
		State and federal personal exposure air quality standards	Personal samples for exposure to aldehydes, VOCs, and particulate matter		
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	High	Increase law enforcement Review annually
Water/Snowpack	Surface water sampling of pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards	Spring runoff surface water sampling	Low	Determination and application of best management practices. Adjust vehicle numbers. Implement/require new technologies for grooming equipment. Review annually
Safety	Conflicts between motorized and nonmotorized use Search and rescue Human and wildlife conflicts	Continuous improvement three-year sliding scale	Incident reports and GIS	Low	Increase law enforcement and information programs in areas of concern Review monthly
Visitor Experience	Encounter rates	Not to exceed 30 to 35 parties per day over 70% of the use season.. Visitors are able to see, smell, and hear the natural environment 90% of the time when on trails greater than ½ mile from destination areas, plowed roads and motorized routes or trails	Visitor survey	Low	Establish carrying capacity/ adjust visitor numbers Review every other year
	Smoothness of groomed surface	No worse than fair 25% of the winter season	Visual observation	Low	Improve or increase grooming Adjust visitor numbers Review annually
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude	Visitors are highly satisfied (90%+) with their park experience	Visitor survey	Low	Establish carrying capacities/ adjust visitor numbers Review every other year

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Table 16. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	7 Ungroomed Nonmotorized Trail or Area				
	Resource Value	Indicator	Preliminary Standard	Method	Monitoring Intensity* Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Adjust vehicle numbers on adjacent motorized routes or trails Review annually
	Wildlife	Human and grizzly bear conflicts during pre- or post denning period	No incidents	Mapping of denning areas	High Increase law enforcement and information programs Close denning areas to human use in fall and spring Review annually
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	High	Increase law enforcement Review annually
Water/ Snowpack	Surface water sampling of pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards	Spring runoff surface water sampling	Low	Determination and application of best management practices Review annually
Safety	Conflicts between motorized and nonmotorized use SEARCH AND RESCUE Human and wildlife conflicts	Continuous improvement three-year sliding scale	Incident reports and GIS	High	Increase law enforcement and information programs in areas of concern Review monthly
Visitor Experience	Encounter rates	Not to exceed 20 to 25 parties per day over 70% of the use season. Visitors are able to see, smell, and hear the natural environment 90% of the time when on trails greater than ½ mile from destination areas, plowed roads and motorized routes or trails	Visitor survey	Low	Establish carrying capacity/ adjust visitor numbers Review every other year
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude	Visitors are highly satisfied (90%+) with their park experience	Visitor survey	Low	Establish carrying capacities/ adjust visitor numbers Review every other year

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Table 17. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	8 Backcountry Nonmotorized Trail or Area				
	Indicator	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act) Regional Haze Rule, no degradation of the 20 best visibility days and improvement of the 20% worst visibility days.	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} and PM ₁₀) IMPROVE protocols	High	Adjust vehicle numbers on adjacent motorized routes or trails Review annually
Wildlife	Human and grizzly bear conflicts during pre- or post denning period	No incidents	Mapping of denning areas Incident reports	High	Increase law enforcement and information programs Close denning areas to human use in fall and spring Review annually
Sound	Distance and time human-caused sound is audible	CFR for vehicle sound	Audibility logging	High	Increase law enforcement Review annually
Water/ Snowpack	Surface water sampling of pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards	Spring runoff surface water sampling Snowpack sampling	Moderate	Determination and application of best management practices Implement/require new technologies Review annually
Safety	Search and rescue Human and wildlife conflicts	Continuous improvement three-year sliding scale	Incident reports and GIS	High	Increase law enforcement and information programs in areas of concern Review monthly
Visitor Experience	Encounter rates	Not to exceed 15 to 20 parties per day over 80% of the use season. Visitors are able to see, smell, and hear the natural environment and experience quiet and solitude 90% of the time when over ½ mile from destination areas, plowed roads and motorized routes or trails	Visitor survey	Low	Establish carrying capacity/adjust visitor numbers Review every other year
	Visitor satisfaction levels with opportunities to experience park values and opportunities to view wildlife, scenery, and experience clean air and solitude	Visitors are highly satisfied (90%+) with their park experience	Visitor survey	Low	Establish carrying capacities/adjust visitor numbers Review every other year

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the season.

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Table 18. Monitoring Standards, Methods, and Intensity by Management Zone, Yellowstone and Grand Teton National Parks and the John D. Rockefeller, Jr., Memorial Parkway Winter Use Plan.

Management Zone →	9 Sensitive Resource Area				
Resource Value	Indicator	Preliminary Standard	Method	Monitoring Intensity*	Management Actions
Air Quality (Public Health)	Visibility	No degradation - (Clean Air Act)	Time lapse video Fixed site sampling of particulate matter (PM _{2.5} , and PM ₁₀) IMPROVE protocols	High	Evaluate success of closure Review annually
Wildlife	Human and grizzly bear conflicts during pre- or post denning period/ closure	No incidents	Mapping of denning areas Incident reports	High	Evaluate success of closure Review annually
Water/ Snowpack	Surface water sampling of pH, Hydrogen, Ammonium, Calcium, Sulfate, Nitrate, and VOCs	State and Federal water quality standards	Spring runoff surface water sampling Snowpack sampling	Moderate	Evaluate success of closure Review annually
Safety	Search and rescue Human and wildlife conflicts	No incidents	Incident reports and GIS	High	Evaluate success of closure Review annually

*High = Daily to weekly or in accordance with standard protocol for parameter; Moderate = Monthly to seasonally and during peak days or use periods; Low = Annually during peak use periods or at the end of the season.